RESULTS OF THE PENNSYLVANIA MOSQUITO SURVEY FOR 1947*

By William L. Brown, Jr.

The Pennsylvania State College

The Pennsylvania Mosquito Survey was begun in February 1947 and became a part of the Pennsylvania Ecological Insect Survey under the direction of Dr. S. W. Frost. The Insect Survey is a function of the Department of Entomology of the Pennsylvania State College. The Mosquito Survey owes its inception mainly to Dr. Frost and to Major Russell W. Gies of the State Department of Health and the Delaware County (Pa.) Mosquito Extermination Commission.

New Jersey Light Traps were obtained from the Communicable Disease Center, U. S. Public Health Service, Atlanta, through the kind offices of Dr. G. H. Bradley. With the placement of the traps throughout the state, transportation difficulties arose that were solved in part through the kindnesses of Major Gies and Dr. Frost, Mr. Leo Sterenberg of the New York Office of the USPHS and others.

The work would have been impossible but for the cooperation of the public-spirited citizens throughout the state who went to the trouble of maintaining and operating their individual traps.

Primary separation was effected by Messrs. Pryor and Kauffman and the Misses Anderson and Pepper under the direction of Dr. Frost. Thanks are due to Dr. E. H. Dusham for administrative aid and direction and to Mrs. Miriam B. Horn for assistance in identification at the New York Office of the USPHS, to the staff of the Delaware County Commission for help of all sorts.

This paper should be used in conjunction with the excellent list of Wilson, Barnes and Fellton (1) and certain papers of Stabler (2 and mss.), to which it is supplementary. Many records of the known mosquitoes of the state are included whether

* A contribution from the laboratories of the Department of Zoology and Entomology of the Pennsylvania State College.

or not the present survey has captured them. Since the southeastern part of the state is best known, the emphasis of this survey was placed more on the central and other parts of the state which have been studied less carefully. An effort was made not only to obtain a more satisfactory idea of the ranges of the various species, but also to gain some idea of the abundance at the different points.

Although only one species hitherto unrecorded from the state has been found this year by the Survey, we believe that the records given below will prove to be of value in rounding out our knowledge of our state's mosquito population as other states have done before us. Since the paper (1) published in 1946 by Wilson, Barnes and Fellton, three additional species of culicids have been found to occur in the state, namely *Aedes mitchellae, Aedes punctor* (or *implacabilis*) and *Megarhinus septentrionalis.* The first and the last named have been reported (mss.) by Dr. R. M. Stabler from Delaware County. The three species named as of probable occurrence in the 1946 paper have not yet been found. *Aedes aurifer* (Coquillett) will sooner or later turn up in a biting collection from within the state. *Anopheles occidentalis* Dyar and Knab has been taken by Perry of the USPHS on the Allegheny River just across the border from Pennsylvania where the river loops into New York State for a short distance. A diligent search in that district should reveal the species; a hurried search by the author in the area of Kinzua turned up only a few *A. punctipennis* females. *Wyeomyia smithii* (Coquillett) occurs only in pitcher plants of the genus *Sarracenia.* The areas in which these plants occur are usually in out-of-the-way bogs and swamps, and the one or two small colonies searched did not contain the mosquito. Search should be made in more extensive pitcher plant areas in the Poconos, and in Sullivan and Lancaster Counties among other regions. *Wyeomyia* will eventually be found if the search is stubborn enough.

In the list of species following we use the generic alphabetic order as do Wilson, Barnes and Fellton. For records of the commoner species, only counties are given, but for the rarer types, we have included more exact data.

The present list includes thirty-seven species of mosquitoes which have been found in this State to date.

1. *Aedes atropalpus* (Coquillett)

This mosquito, a breeder in rock holes, was first reported by Howard, Dyar and Knab from Shenk's Ferry in Lancaster Co. It probably occurs at many points farther up the Susquehanna and along other rocky rivers and streams in the state. We have found it breeding abundantly along the Youghiogheny River at Ohiopyle, Fayette Co., and have taken a specimen from the trap operated by Mr. Edward J. Pugh, Director of Health, at Wilkes Barre, Luzerne Co., which is on the bank of East Branch of the Susquehanna. At Ohiopyle, the first breeding occurred in 1947 only after the 20th of April. The 1947 records are the first for over thirty years in Pennsylvania.

2. *Aedes canadensis* (Theobald)

This mosquito is far and away the commonest early spring breeder in the state. The author feels that it occurs in every county in the state, breeding in open situations as well as in woodland pools. It begins breeding in Delaware Co., during the first or second week of March, usually a little later elsewhere, and in 1947 was strongly retarded in the cooler parts of the state except, for some unexplained reason, in the northeastern region, where heavy breeding occurred throughout April.

The Survey has taken *canadensis* in the following counties from which it has not been recorded previously: Blair, Center, Clearfield, Crawford, Carbon, Erie, Huntingdon, Luzerne, Mifflin, McKean, Northumberland, Philadelphia, Schuylkill, Westmoreland and Wayne.

3. *Aedes cantator* (Coquillett)

Aedes cantator has so far been reported only from the southeastern part of the state. The Survey has one specimen from the trap at the Philadelphia Navy Yard operated by Lieutenant Holway, as well as scattered specimens from various localities in Delaware Co., collected by the Delaware County Mosquito Extermination Commission.

4. *Aedes cinereus* (Meigen)

This small and inconspicuous mosquito has heretofore been considered rather rare in the state. The author agrees with Stabler that it is not uncommon in several localities in Delaware Co., and he will go further and state that he has found it among the commonest of mosquitoes during spring and early summer in other parts of the state. At Philipsburg in mid-April the larvæ were associated in enormous numbers with those of *A. canadensis* in open swamps and grassy ponds as well as in woodland pools. This association of *canadensis* and *cinereus* seems to replace in Pennsylvania the association of other *Aedes* spring forms found farther north.

In addition to the above localities, breeding of *cinereus* was observed to be common at Ole Bull State Park, Potter Co., again with *canadensis,* and many males were captured during May, June and July in the light trap at that place.

Taken by the Survey in Centre, Clearfield, Erie, Fayette, Philadelphia and Potter counties; by the Delaware Co. Commission in Delaware Co., and Montgomery Co., and by Wilson, Barnes and Fellton in Mercer and Wayne counties.

5. *Aedes dorsalis* (Meigen)

We have not seen any specimens during 1947. Formerly reported only from Philadelphia by Dyar.

6. *Aedes excrucians* (Walker)

This species was fairly abundant in the Philipsburg area (Centre and Clearfield Counties) in the swamps on both sides of Moshannon Creek during May. Both male and females were captured flying low among cattails at dusk during the last week in May; the females made no attempt to bite and fled at the approach of the collector. Mating was in process at the time. Male specimens were captured in June, one in the trap at State College, Centre Co., and two in the trap at Wilkes Barre, Luzerne Co. Male genitalia were checked on specimens from each locality.

7. *Aedes fitchii* (Felt & Young)

This Survey identified no *fitchii* from among the 1947 catches.

Wilson, Barnes and Fellton claim to have captured a few specimens in Bucks County during 1945.

8. *Aedes mitchellae* (Dyar)

Stabler took this species in Delaware Co., (Norwood, Tinicum) during 1946 (mss.) from the light trap catches.

9. *Aedes punctor* (Kirby)

This species is very difficult to separate from *A. implacabilis* (Walk.) in the female sex. We have checked a single specimen taken biting at Philipsburg, Centre Co., against specimens in other collections, and it seems to have more exactly the features of *punctor* than those of its close relative. Neither *punctor* nor *implacabilis* has been previously reported from the state.

The taxonomy of the *punctor-implacabilis* and the *fitchii-stimulans* groups of *Aedes* seems to this writer and to other entomologists engaged in mosquito work to be very dubiously applied. Work on these and other domestic *Aedes* complexes has been virtually stalled, probably due to the appearance of large illustrated works on identification which have given an air of stability to the names presently in use. The occurrence of intergrading forms in the larvæ and both sexes of adults in a large series from New Jersey of the *fitchii-stimulans* group seems suspicious. The matter can be settled only by the rearing of large series from a fair sample of the full ranges of the groups in question.

10. *Aedes sollicitans* (Walker)

This annoying mosquito breeds in Delaware and Philadelphia counties in small numbers except during dry seasons, when, as in late summer 1947, the Delaware River may become slightly brackish, with sea water making itself felt as far up as Chester, Delaware Co., or even farther upstream. The slight brackishness is reflected in an immediate rise in the number of *A. sollicitans* caught in the light traps in Delaware and Philadelphia counties. The adults locally produced are probably augmented by migrating swarms from Delaware and New Jersey when the wind is right.

11. *Aedes sticticus* (Meigen)

This species was taken in large numbers only on Presque Isle, Erie Co., where the adults were troublesome in the woods during the day in July. By early August, they were present in immense swarms on much of the peninsula and would attack in midday, hot sunlight on the open beaches and roads about the woods wherever the stronger breezes could not reach them. A single male was taken at Honesdale, Wayne Co., on July 10, the genitalia verified.

12. *Aedes stimulans* (Walker)

Taken by USPHS group in the northwestern and southeastern portions of the State. Neither this Survey nor the Delaware County Commission has been any clearcut examples of this supposedly common mosquito.

13. *Aedes taeniorhynchus* (Wiedemann)

Known only from Philadelphia and Delaware counties; may occur in Montgomery, Chester and Bucks.

14. *Aedes triseriatus* (Say)

This mosquito was taken fairly abundantly in biting collections during June, July and August at Tiadaghton, Lycoming Co.; Presque Isle State Park, Erie Co.; and near Philipsburg in Centre and Clearfield Counties. Major Gies has taken it at Old Forge State Park in Franklin Co. One specimen was caught in the light trap at Ohiopyle, Fayette Co., during June. The author has observed them to be breeding in large numbers in tree holes in Aldan, Media and Tinicum, all in Delaware Co. In wooded areas in Delaware County, the mosquito is often quite troublesome. In Aldan and Media during July, however, the numbers of *triseriatus* larvæ were considerably reduced by the voracious *Megarhinus* larvæ feeding upon them.

15. *Aedes trivittatus* (Coquillett)

Aedes trivittatus was taken in moderate numbers from most of the light traps throughout the State and was taken abundantly in biting collections along Moshannon Creek near Philipsburg, Centre and Clearfield Counties, up until the time of air-

spraying with DDT. Major R. W. Gies has taken them biting at Old Forge State Park, Franklin Co., along with *A. triseriatus*. The trap catches of *trivittatus* were small except at Ohiopyle, Fayette Co., where as many as 100 per night were taken during July. Males were taken in approximately equal proportion to females except in the case of the large Ohiopyle catches, where females were very much in the majority. Trapped in: Blair, Delaware, Erie, Centre, Clearfield, Fayette, Luzerne and Potter Counties. Biting in: Adams, Franklin, Lycoming, Centre, Clearfield, Erie Clinton and Mifflin counties.

16. *Aedes vexans* (Meigen)

This species, along with the *pipiens* group of *Culex*, is the principal pest in Pennsylvania. It was found during the summer in just about every locality visited, and the author does not hesitate to assert his belief that it occurs commonly in every county in the state. It is especially common in the vicinity of inhabited places, though it is also found in wilder districts. Taken in the following counties: Blair, Centre, Clearfield, Delaware, Erie, Clinton, Wayne, Bedford, Adams, Crawford, Montgomery, Berks, Warren, McKean, Potter, Lycoming, Fayette, Mercer, Mifflin, Huntingdon, Luzerne, Philadelphia, Westmoreland, Indiana, Armstrong, Butler, Forest, Elk, Juniata, Cameron, Washington, Venango and Bucks. It exceeded an average of 12 per night for a month or more at the following localities: Tinicum, Delaware Co.; Presque Isle, Erie Co.; Pymatuning, Crawford Co.; Altoona, Blair Co.; Ole Bull Park, Potter Co.; Ohiopyle, Fayette Co.; Philipsburg area, Centre and Clearfield Counties at Moshannon Creek. Ohiopyle, Presque Isle, and Philipsburg were the heaviest catchers (outside Delaware Co.), with catches of one to three hundred per night not uncommon.

A specimen given me by Dr. Stabler, collected in Delaware County and now deposited in the collection of the Pennsylvania State College, differs from the typical *vexans* in having, in addition to the inverted V-shaped white patch at the anterior of each dorsal abdominal segment, a large, central, posterior patch of white scales which is half-oval or subtriangular in shape with the narrowest part directed anteriorly. Mrs. Horn informs me

that similar specimens turn up occasionally and that intergrades to the typical *vexans* occur, some specimens having only a few white scales at the posterior edge of each abdominal specimen. Such intergrades would not necessarily preclude the possibility of these aberrant individuals forming an ecological race of *vexans*. More specimens are needed for study.

17. *Anopheles barberi* (Coquillett)

This small tree-hole breeder has previously been taken in Butler and Cumberland Counties. I have seen specimens taken in light traps by Dr. R. M. Stabler of the Delaware County Mosquito Extermination Commission during several of the more recent years. I believe he will mention these records in a forthcoming paper. One additional record is added: Crooked Creek Reservoir, Armstrong Co.—one adult female taken by N.E. Good of the USPHS on Sept. 12, 1945 at an adult resting station. *Barberi* is probably present but difficult to locate throughout most of the State.

18. *Anopheles crucians* Wiedemann

Known from Philadelphia, Delaware and Montgomery Counties.

19. *Anopheles punctipennis* Say

This species is usually regarded as unimportant in the transmission of malaria, though it has been experimentally infected in the laboratory. It differs in distribution from other species of the state in that it is present in nearly every locality examined, but usually not in very large numbers. *Quadrimaculatus* and *walkeri*, on the other hand tend to have a localized distribution in the extreme northwestern and southeastern parts of the state, and quite often are exceedingly abundant where they are found. *Punctipennis*, at least in this state, is certainly not shy about entering houses or biting humans indoors or out. During 1946 in State College, Centre Co., females were seen in houses during October and November, apparently seeking shelter for hibernation, and during August 1947, several cases of *punctipennis* biting were observed here indoors. At Ohiopyle, Fayette Co., where the species was commoner than elsewhere (often 10 to 12 per

night in the trap), individuals bit freely on porches and in gardens at dusk and after dark. At this last-named locality, the larvæ were breeding in many of the rock holes along the Youghiogheny River.

Males of this and other species of *Anopheles* were taken only very rarely in the light trap. Specimens from traps and adult resting-places in the following counties: Blair, Centre, Crawford, Delaware, Fayette, Luzerne, Lycoming, McKean, Potter and Warren. Unpublished records of the USPHS are as follows: Conemaugh and Loyalhanna Reservoirs (sites) (Westmoreland Co.), Crooked Creek and Mahoning Dams (Armstrong Co.), Smicksburg (Indiana Co.), Confluence (Somerset Co.); [N.E. Good], Sept. 1945.

20. *Anopheles quadrimaculatus* Say

This well known malaria mosquito has so far been taken in three general regions of the State. It is sometimes fairly commonly seen in Philadelphia and Delaware Counties and is less common in Montgomery County. Gies and Stabler have collected it in Chester County and Gies in Berks County. The present author has found it to occur sparingly in Bucks County. Dr. Mitchell Carroll, head of the Zoology Department at Franklin and Marshall College, [Lancaster Co.], reports fairly heavy numbers of hibernating "quads" in some of the college buildings in former years. The MCWA personnel of the USPHS have found it common in mid-summer in scattered localities in Crawford and Mercer Counties. The present survey can add a report of an abundant population on the peninsula at Presque Isle, Erie Co., during the summer of 1947. Major R. W. Gies had already noted its abundance at Presque Isle during the month of October in 1946. On the peninsula, the mosquito is most abundant in natural and artificial resting places, such as hollow logs, bath-houses, privies, etc. It is not well represented, however, in the light trap collections at this locality, where *A. walkeri* was found to be taken so commonly. The one other section of the State in which it has been found is the lower Susquehanna River region, where it has been recorded from West Fairview, Cumberland Co., by Howard, Dyar and Knab. This is

one of the few known records from outside the extreme northwestern and southeastern portions of the state. Major R. W. Gies has suggested, and I concur, that *A. quadrimaculatus* population may be large locally in many localities in parts of the State as yet unsurveyed, and that cyclic increases in abundance over a period of years may play a role in distribution. Further surveys will be needed to determine the frequency of such phenomena.

A record from the USPHS files received at the last moment is of interest. Two females were taken in separate resting places near the Mahoning Dam, Armstrong Co., by N. E. Good during September 1945. Two trips to that area by the present writer during 1947 failed to reveal *quadrimaculatus*.

21. *Anopheles walkeri* Theobald

A few specimens of *walkeri* have been taken in the traps of the Delaware County Mosquito Extermination Commission, but the most phenomenal catch seen was that of the Survey's trap on the neck of the peninsula at Presque Isle State Park, Erie Co. This trap was placed about ten feet higher than the regulation six on the limb of a poplar tree. During July it commonly made catches of 50–120 *walkeri,* and on the night of August 8 exceeded 550. A search of resting places such as dark privies and bath-houses was fruitless as far as revealing specimens was concerned, although *A. quadrimaculatus* and a few *A. punctipennis* were found, along with species of other genera. None of the other traps turned up *walkeri* during the season. Thus *walkeri,* like *quadrimaculatus,* seems to find conditions most favorable in the northwestern and southeastern portions of the state.

22. *Culex apicalis* Adams

Previous authors have found this species widely distributed in the State. It is supposed to take its blood from amphibians; data are needed on the adult feeding habits. The Survey has taken a few specimens each from traps in Erie, Luzerne, Fayette and Potter counties. Males were taken in the traps more commonly than females. Adults were reared from larvæ taken in

rockholes along the Youghiogheny River at Ohiopyle, Fayette Co., May 8, 1947.

23. *Culex* (*Melanoconion*) sp., probably *erraticus* Dyar and Knab.

Known only from two specimens taken in the Philadelphia area by Dr. R. M. Stabler.

24. *Culex pipiens* Linnaeus

The common house mosquito has been found to be common mainly in the urban areas, and has not been taken as frequently as has *C. restuans* in other areas of the state. Traps at sewage works in Altoona and State College yielded quite different catches, the former giving up nearly all *pipiens* and the latter nearly all *restuans*. The author has no good explanation for this. In general, *pipiens* tended to become slightly more and *restuans* slightly less abundant with the passing of July. In several areas, search for females in resting places during April and May yielded only *restuans*. Thus, it seems that, in Pennsylvania at least, the two species *may* be seasonally different in breeding habits.

New records resulting from the survey in the following counties: Bedford, Centre, Clearfield, Crawford, Erie, Fayette, Luzerne, Mifflin. Records from several counties covered by Wilson, Barnes and Fellton are not included here. The species certainly occurs in every county in the state.

25. *Culex restuans* Theobald

This species requires great care in separation from related species of *Culex*. We have found it more common than *pipiens* in most sections of the state, breeding in all sorts of situations, in clear water and foul, in tin cans, temporary pools and rain barrels. Specimens carefuly reared from such situations nearly always turned out to be typically white-spotted *restuans*, although such places are generally thought to be principally the breeding domain of *pipiens*. Many males and females, the latter predominating, from the light traps in Blair, Centre, Clearfield, Delaware, Erie, Crawford, Bedford, Luzerne, Lycoming, Potter and Wayne counties. Other specimens, both larval and adult, were taken in Carbon, Mercer, Fayette, Huntington, Mif-

flin, Allegheny, Warren, Clinton, McKean, Chester, Lancaster, Bucks, Lehigh and Schuylkill counties. The species undoubtedly occurs in every county in the state; it is among the commonest mosquitoes in most.

26. *Culex salinarius* Coquillett

The survey found *salinarius* to be much less common than either *pipiens* or *restuans*. It was taken from light traps in the following Counties: Crawford, Erie, Fayette and Wayne. Since the specimens in many cases were too badly damaged to differentiate *salinarius* from the other two common species, the range may be more extensive than our records show. Previous papers seem to bear this out.

27. *Culiseta inornata* (Williston)

Heretofore known only from Delaware and Philadelphia Counties. The Survey took a female specimen from the trap on Presque Isle Penninsula, Erie Co., July 24, 1947.

28. *Culiseta melanura* (Coquillett)

This species is known only from Delaware County.

29. *Culiseta morsitans* (Theobald)

This species was taken in larval dippings in a flooded area of bunch grass together with *Aedes canadensis* and *A. cinereus* at Ole Bull State Park, Potter Co., during May. A male was caught in the same locality in the light trap, July 6, 1947, and a female was taken in the trap at Ohiopyle, Fayette Co., August 13th. Previously recorded from Butler and Monroe counties.

30. *Mansonia perturbans* (Walker)

The larvæ of this mosquito live beneath the surface of the water with their air tubes piercing the roots of aquatic plants for air supply. The species has heretofore been considered common only in southeastern Pennsylvania, but we have taken it in light traps in the following counties outside that area: Blair, Centre, Clearfield, Erie and Potter. The catches have ranged from 1 to 25 individuals per night, with about 4 or 5 as a normal number in all stations but Philipsburg, Centre Co., where the catch was averaging 20 or so two weeks after air-

spraying of the area with one gallon of 5 per cent DDT (in kerosene) to the acre. Males are attracted in a proportion of about one to every two or three females, but they occasionally (Ole Bull, Potter Co.) slightly outnumber the females in the New Jersey trap.

31. *Megarhinus septentrionalis* Dyar and Knab

Stabler (mss.) reports a specimen taken in Delaware Co. during 1946. The author can add observations of breeding in treeholes in Aldan, Tinicum and Media, Delaware Co., where the prey seemed in all cases to be *Aedes triseriatus*. Populations of *triseriatus* were greatly reduced and even obliterated during early and mid-July by the feeding of the *Megarhinus*. Several specimens were taken home, put in a jar with many *triseriatus* larvæ, and watched periodically. The first night, July 2, the largest *Megarhinus* larva attacked and ate two *Aedes* during a twelve-hour period. The largest *Megarhinus* survived as a fourth instar larva for 13 days after the last *Ædes* and smaller *septentrionalis* larvæ had disappeared. Presumably the latter were eaten by the large larva, since the empty larval skins were found in halves at the bottom of the jar and seemed in a condition similar to those of the *Aedes* preyed upon. This is the first record of *Megarhinus* actually breeding within the state.

32. *Orthopodomyia signifera* (Coquillett)

This rather rare treehole breeder should be closely scrutinized whenever found, since the closely related *O. alba* Matheson may quite possibly be found in this state. The Survey has taken a single specimen each from the traps in Nanticoke, Luzerne Co., Williamsport, Lycoming Co., and Ohiopyle, Fayette Co. Previous reports are from Philadelphia and Delaware counties. The mosquito is probably rare but present in most of the state.

33. *Psorophora ciliata* (Fabricius)

The Survey has failed to turn up any new records of this mosquito in the state outside of southeastern Pennsylvania, although it may well occur in other parts.

34. *Psorophora confinnis* (Lynch Arribalzaga)

All records of this insect seem to center in the southeastern part of the state; the Survey has nothing to add in the way of

distributional data. Previously known from Philadelphia, Delaware and Montgomery counties.

35. *Psorophora ferox* (Humboldt)

The mosquito has been reported from Montgomery and Philadelphia Counties only, but the writer has a few specimens collected by Stabler (1945, 1946) and McGaughey (1947) in Delaware Co.

36. *Psorophora horrida* (Dyar and Knab)

This species has been taken only once in Pennsylvania—by the USPHS group in 1945. We have seen no further specimens from the state.

The collection of the Pennsylvania State College received several fine specimens of this mosquito collected by Mr. Merrill Wood of the Department of Zoology and Entomology during July 1947 near Fremont, Nebraska. Mr. Wood states that this species is a most vicious biter throughout much of that state.

37. *Uranotænia sapphirina* (Osten Sacken)

This species is probably a feeder upon frogs, since it seems to occur only where the latter amphibians are abundant. A related species, *U. lowii* Theobald has been demonstrated by Remington (4) to be a feeder mainly upon frogs, toads and related amphibians. Captured in light traps in Blair, Delaware, Erie, Luzerne, Lycoming and Potter counties. Five individuals is the maximum catch for one night; males and females come to the traps in approximately equal numbers.

References

For a fuller bibliography on Pennsylvania mosquitoes, see reference (1) below. The following are papers referred to in this paper:

(1). WILSON, C. A., R. C. BARNES AND H. L. FELLTON 1946. A list of the mosquitoes of Pennsylvania with notes on their distribution and abundance. Mosquito News Vol. *6*, No. 2.

(2). STABLER, R. M. 1946. New Jersey light trap versus human bait as a mosquito sampler. Ent. News *56:* 93–99.

(3). ————————. mss. (An unpublished paper giving further mosquito records from Delaware County.)

(4). REMINGTON, C. L. 1945. The feeding habits of *Uranotænia lowii* Theobald. Ent. News *56:* 32–37, 64–68.